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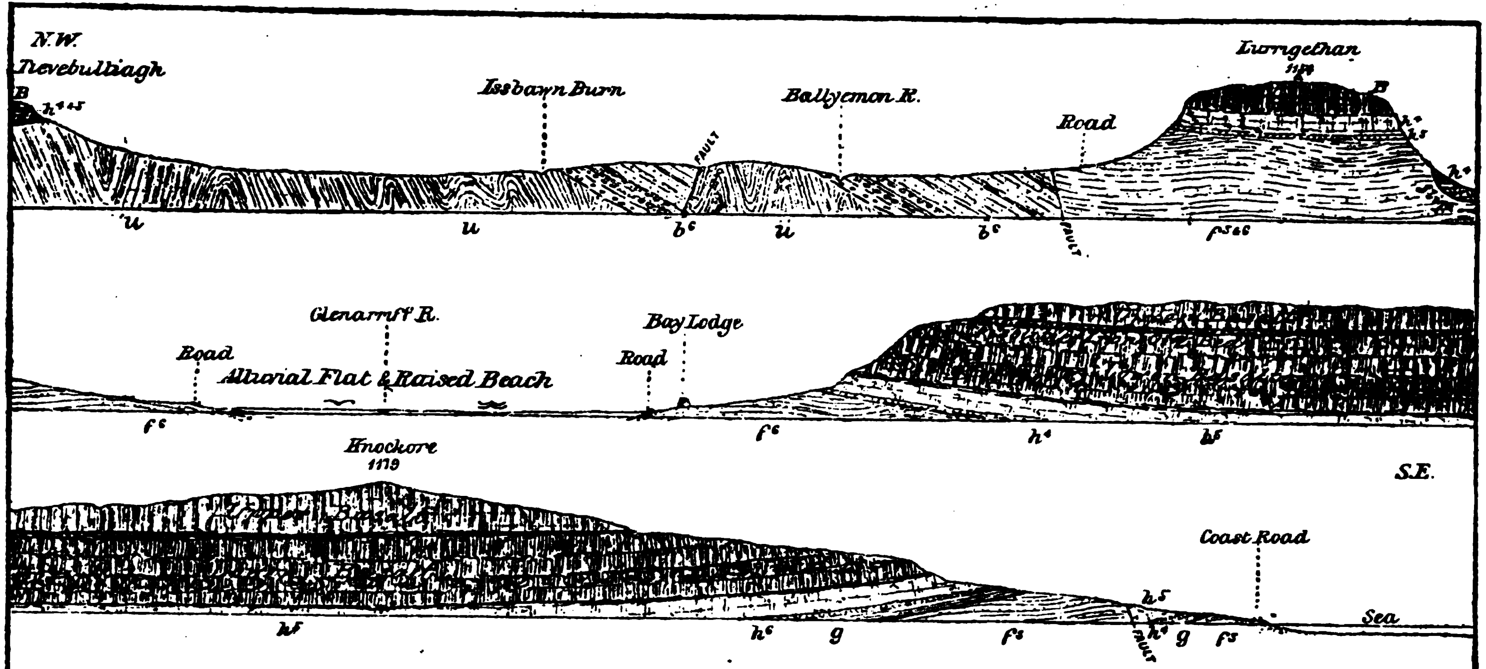
FRONTISPIECE.

Horizontal Section in a N.W. S.E. Direction across the Hills South of Cushendall. Co. Antrim.



B. Upper and Lower Basalt. h^5 Upper Chalk. h^4 Upper Greensand. g. Lower Lias $f^{5\&6}$ New Red Marl, Sandstone and Conglomerate. b^6 Lower Old Red Sandstone and Conglomerate (Dingle Beds.) u Metamorphic Rocks.

(Scale 1 mile to 3 inches.)

14.

Memoirs of the Geological Survey.

EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 14 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND,

BY

RICHARD G. SYMES, M.A., F.G.S.,

AND

ALEXANDER M'HENRY, M.R.I.A.

WITH

PALÆONTOLOGICAL NOTES BY W. H. BAILY, F.G.S., &c.

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CONTENTS.

CHAPTER I.

Page
Physical Geography, ... 7
River Basins, and Drainage, ... 10

CHAPTER II.

Metamorphic Series—Gneiss and Schist, ... 11
Aqueous Rocks—Rock formations and Divisions, ... 10
„ Lower Old Red Sandstone "Dingle beds," . . . 12
Triassic—Keuper Marls and Sandstones, ... 13
Liassic—Lower Lias, ... 15
Cretaceous—Upper Greensand, ... 15
„ Upper Chalk, ... 15
Volcanic Rocks—Upper Basalt, ... 22
„ Iron ore deposits, and volcanic ash, ... 20
„ Lower Basalt, ... 17
„ Dykes, ... 23
Igneous Rocks—Felstone porphyry, ... 25
„ Quartz porphyry, ... 26
Post Pliocene—Drift, boulder clay, interglacial sand and gravel, . . 27
Recent Accumulations—Bog, raised beach, blown sand, . . . 28

CHAPTER III.

Principal Faults, ... 29
Glaciation, ... 31

CHAPTER IV.

Palæontological Notes, ... 32

PREFACE.

THE geological survey of Sheet 14, was carried out during the years 1881–83, by Messrs. Symes and M'Henry, the former over the southern part of the sheet, the latter, over the northern. The district presents some of the more striking features in the scenery of county Antrim; and no one visiting it can fail to be struck with its fine headlands and deep glens opening out upon the sea-coast. As regards its geological structure, there are several points which call for special notice; amongst which may be mentioned the volcanic phenomena, on the one hand, and the occurrence of the ancient crystalline schist and gneiss which are the foundation rocks of this part of Ireland, on the other. As regards the geological age of these latter rocks we are at present in a state of much uncertainty. Sir R. Griffith has placed them in his "Primary system" below the Cambrian. The final determination of their age will probably have to remain over till the completion of the survey of the Western Highlands of Scotland, into which the metamorphic beds are prolonged beneath the intervening straits. Those who are acquainted with the geological structure of Argyleshire, will recognise the similarity of the succession in some parts of that district with that here described. In both we find the old crystalline rocks overlain unconformably by massive conglomerates of the Lower Old Red Sandstone formation, which to a great extent have been constructed from fragments of the older rocks; and it is not improbable that there was originally, if there is not actually, a physical connexion between the conglomerate masses on both sides of the straits.

EDWARD HULL,
Director.

THE
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ARCHIBALD GEIKIE, LL.D., F.R.S.

Geological Survey Office and Museum of Practical Geology, Jermyn-street, London.

IRISH BRANCH.

Office, 14, *Hume-street, Dublin.*

DIRECTOR:
EDWARD HULL, LL.D., F.R.S., F.G.S.

DISTRICT SURVEYOR:
G. H. KINAHAN, M.R.I.A., &C.

SENIOR GEOLOGISTS:
W. H. BAILY, F.G.S., L.S., (Acting Palæontologist); **R. G. SYMES, M.A., F.G.S.**;
S. B. N. WILKINSON; **J. NOLAN, M.R.I.A.**

ASSISTANT GEOLOGISTS:
R. J. CRUISE, M.R.I.A.; **F. W. EGAN, B.A.**; **E. T. HARDMAN, F.C.S.**; **J. R. KILROE**; **W. F. MITCHELL**; and **ALEX. M'HENRY, M.R.I.A.**
A. B. WYNNE, F.G.S., Resident Geologist, Acting Secretary.

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R. CLARK.

The observations made in the course of the Geological Survey, are entered, in the first instance, on the Maps of the Ordnance Townland Survey, which are on the scale of six inches to the mile. By means of marks, writing, and colours, the nature, extent, direction, and geological formation of all portions of rock visible at the surface are laid down on these maps, which are preserved as data maps and geological records in the office in Dublin.

The results of the Survey are published by means of coloured copies of the one-inch map of the Ordnance Survey, accompanied by printed explanations.

Longitudinal sections, on the scale of six inches to the mile, and vertical sections of coal-pits, &c., on the scale of forty feet to the inch, are also published, and in preparation.

Condensed memoirs on particular districts will also eventually appear.

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EXPLANATORY MEMOIR

TO ACCOMPANY

SHEET 14 OF THE MAPS

OF THE

GEOLOGICAL SURVEY OF IRELAND.

CHAPTER I.

PHYSICAL GEOGRAPHY.

The district included in the northern half of Sheet 14, extends from the River Bush, near Armoy, on the west, to the sea coast on the east at Cushendun, and southwards to Red Bay.

Situated in it are the villages of Cushendun and Cushendall, the former being on the sea coast, the latter three and a half miles south of it, and a quarter of a mile from the shore.

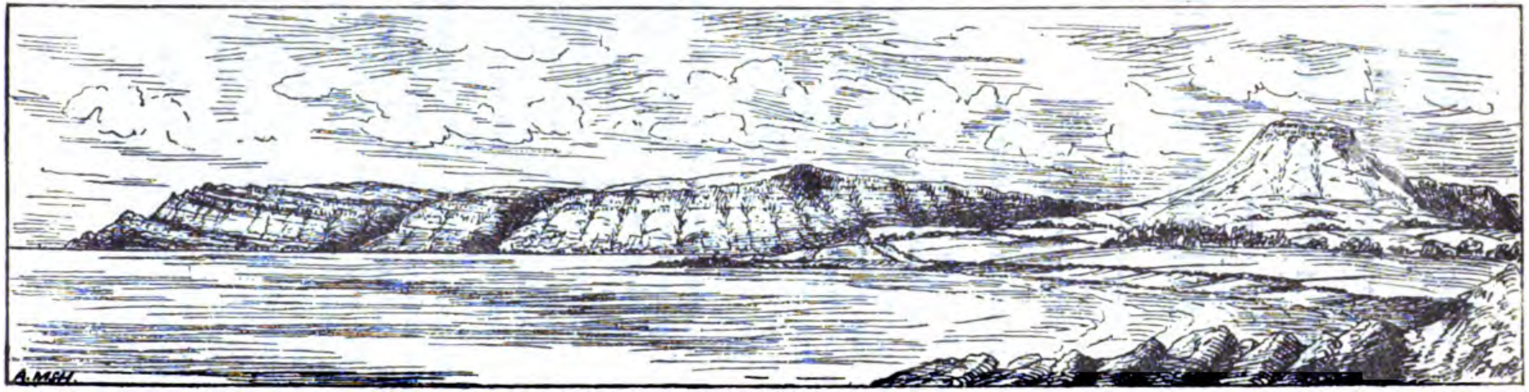
The country in the above area is very hilly, and traversed by deep picturesque glens which run in north-west and north directions.

The high ground is invariably covered by a thick coating of peat bog, while the slopes of the glens are steep and rocky.

The river valleys are those of the Bush on the extreme west into which run a few minor valleys from Croaghan mountain. Next is the Glenshesk river valley which commences on the north slope of Slieveanorra mountain and runs in a northerly direction into Ballycastle Bay. To the east again is the Glendun river which takes its rise on the south-west slope of Trostan mountain and flows in a north, and then north-east, course into Cushendun Bay. Three small streams, the Glenaan, Issbawn, and Ballyemon, descend also from the north and east sides of Trostan mountain, and uniting a little west of the village of Cushendall, flow through it to the sea, between Limerick Point and Port Vinegar. In the extreme north-west is the Well Water burn, which takes a westerly course into the River Bush near Armoy.

The principal elevations are Crockaneel (1,321 ft.), Oghtbristacree (1,250 ft.), and Agangarrive (1,225 ft.) Of the north-east and south-west range between Glendun and Glenshesk, south-east of the foregoing, and ranging in the same direction between Glenaan and Glendun, are Gruig Top (1,123 feet), and Crocknacreeva (992 feet). To the west between Glenshesk and the Bush valley are Croaghan (1,368 feet), and Bohilbreaga (1,077 feet).

Fig. 2.



View from Port Vinegar looking South across Red Bay. Garron Point on the left. Glenariff in the centre, and Lurigethen Mountain on the right.

All these hills are composed of the metamorphic rocks, and present a well rounded, or ice-worn, appearance, and are invariably covered by Boulder Drift, and this again by thick peat bog. Croaghan mountain is the only exception, its summit being capped by a small outlier of Cretaceous rocks and basalt.

Lurigethan (1,154 feet), forms a picturesque feature in the country to the south, being the dividing ridge separating the Glenariff and Ballyemon glens. It is composed of New Red Sandstone, marl, and conglomerate capped by Cretaceous rocks and basalt—the latter formations producing the magnificent escarpments which fringe those glens and others to the south of them. From the base of the Cretaceous beds the hills in all cases rapidly slope to the bottom of the valleys; the slope, however, becomes more gentle as it reaches the low ground.

These fine escarpments and deep valleys indicate the enormous amount of denudation which has taken place over the whole country.

Cross Slieve (673 feet), which is the culminating ridge of the Old Red Sandstone between the glens of Cushendall and Cushendun, presents a rounded form, and is uncovered by either drift or peat.

The coast line is in general bold and precipitous north of Cushendall. South towards Glenariff it is rather low and undulating, and exhibits some fine examples of the old sea caves of the "twenty-five feet raised beach." They are to be seen at Red Bay tunnel and south of it, excavated out of the New Red Sandstone—the principal one being called "Nanny's Cave." A little S.E. of Cushendun, there are also some very fine and extensive sea-caves occurring in the conglomerates of the Old Red Sandstone.

The raised beach itself ranges from the twenty-five to the forty feet contour, and is well marked along the coast at several places between Cushendun and Glenariff—forming a slight escarpment, or cliff of drift and rock along its course.

A. McH.

The southern half of the sheet has for its eastern boundary the shore extending from Red Bay to Glenarm Bay; its southern boundary runs from Glenarm Bay westwards past the R. C. chapel south of Newtown Crommelin; while its western boundary extends in a N. and S. line half a mile east of the villages of Clogh Mills and Armoy, both of which are in Sheet 13. In it are situated the villages of Carnlough, Glenariff or Waterfoot, and Newtown Crommelin.

This portion of the sheet, together with that to the north, forms a part of the elevated table land of the county Antrim, and is indented with deep valleys. The highest points of elevation, are Trostan, the loftiest mountain in the county Antrim (1,817); Slieveanorra (1,676); Aghan (1,197); Tievebulliagh (1,346); Crockalough (1,304); Slievenahanaghan (1,325); Slievenanee (1,782); Slieverush (1,140); Craigagh (996); Collin Top (1,426);

Binnagee (1,127); Little Trosk (1,262); Knockore (1,179); Carn Neill (1,304); Evish (819). All these heights, with the exception of Crockalough (1,304), are capped with Upper Basalt, and contain beds of pisolitic iron-ore, "pavement," and lithomarge. Crockalough is capped with Lower Basalt.

The shore line from Glenarm Bay northwards, presents the most picturesque scenery in the county Antrim: bold precipitous cliffs intersected by valleys stand out in strong relief. Landslips are numerous along the escarpments; as the Lias clay at the base of the cliffs becomes saturated with the springs coming from the Chalk; the result being that the Chalk with its capping of basalt slides downwards over the New Red Marls. These slips often encroach on the road, and render it impassable; as, for instance, on that part between Glenarm Bay and Carnlough Bay, as well as west of Garron Point, where the mud of the Lias is mixed up with fragments of chalk, basalt, &c.

RIVER BASINS AND DRAINAGE.

The sources of the Rivers Bush, Glendun, Cushendall, Glenariff, also Ballsallagh, Cargan, Skerry, Tullykittagh, and Aghanageeragh, tributaries of the Maine Water, one of the great feeders of the River Bann, all occur in the central portion of the sheet.

The watershed separating the Glendun, Glenaan, and Glenariff rivers which flow east, from the Bush and Glenshesk which flow north, enters the district on the N.E. and passes in a S.W. direction over Crockaneel, Agangarrive as far as Slieveanorra; from thence it goes S.E. over Eagle Hill, Evish Hill and Collin Top, and passes out of the district on the S.E.

R. G. S.

CHAPTER II.

ROCK FORMATIONS AND DIVISIONS.

Aqueous Rocks.

Name.			Colour on Map.
Recent, . .	Blown sand, . . .		*Red dots on white ground.*
„ . .	Bog and alluvium, .	⌒⌒	*Chalons brown and gamboge.*
„ . .	Raised beaches, . .	≋≋	*Chalons brown and gamboge.*
Post-Pliocene (Drift).	Sand and gravel, . .		*Engraved dots.*
	Lower boulder clay, .		

Tertiary Volcanic Rocks.

Basalt and Dolerite.	Upper basaltic sheets, .	B	*Burnt carmine (deep).*
	Iron ore with Lithomarge, . . .		*Light reddish brown and gold dots.*
	Lower basaltic sheets, .	B	*Burnt carmine (light).*
	Intrusive necks and dykes, . . .	B ↑	„ „ *(deep).*

Aqueous Rocks—continued.

Name.			Colour on Map.
Cretaceous, .	Upper Chalk with flints,	h^5	*Emerald green (light).*
„ .	„ Greensand, .	h^4	„ „ *(dark).*
Liassic, . .	Lower Lias, . . .	g^1	*Chalons brown and gamboge.*
Rhætic, .	. . . .	fg	
Triassic, .	Keuper Marl, sandstone, and conglomerate, . . .	$f^{5,6}$	*Venetian red (light).* „ „ *(deep).*
Lower Old Red Sandstone= "Dingle Beds."	Sandstone and conglomerate, . . .	c^1	*Indian red and purple.*

Metamorphic Sedimentary Rocks.

Mica Schist, Hornblende Schist, &c., .	μ	*Pale pink.*
Gneiss, ...	ν	„
Crystalline Limestone, ...	λ	*Cobalt.*

Igneous Rocks.

Felstone Porphyry, ...	Fp ↑	*Vermillion (light).*
Quartziferous Porphyry, . . .	E ↑	*Carmine (deep).*

METAMORPHIC ROCKS.

Schists and Gneiss.—These consist chiefly of hornblendic and micaceous varieties, passing into gneiss distinctly foliated, and constitute the fundamental rocks of this part of Ireland. In the Bush river, as well as in its tributary the Aldorough burn, a continuous section was noted of flaggy glistening mica schist, with occasional bands of hornblendic schist, having a general dip to the W.N.W. Traversing these schists are some large quartz veins.

Following the Bush river towards the S.E. regularly bedded micaceous schists are met with, the foliation coinciding with the bedding.

In the Glendun river, and its tributary the Bryvore water, there occur both schists containing garnets, and gneiss, the passage from one to the other not being well defined; the general inclination of bedding and foliation being towards the east, while in the west of the district the schists dip westward. These schists also contain numerous quartz veins.

In the Issbawn burn, which flows through Cushendall, there is a continuous section for about a mile of glistening mica schists, with a steady N. and S. strike. In the Glenaan river, north of the Issbawn, the same schists are represented, but the strike is inclined to the N.N.W., and the beds westward towards Crockan merge into gneiss: this gneiss contains pink felspar, oligoclase, hornblende, glassy felspar, and silvery mica.

In the Ballyemon river, three miles S.W. of Cushendall are two small exposures of mica schist covered by Lower Old Red Sandstone, and this, in turn, capped by New Red Sandstone, Greensand, Chalk, and Basalt.

R. G. S.

In the northern half of the district extensive sections of these rocks are to be met with in all the cuttings of the rivers and mountain-streams; also, along the escarpments of the hills, and on the coast line. They are principally micaceous, but often highly felspathic and hornblendic; sometimes gneissose in character, in which latter case they are generally of a pinkish colour; while the hornblendic schists—which are principally confined to the district about Cushendun—are of a dark green colour, sometimes nearly black, and dense in texture.

No definite boundary can be drawn on the ground between the different varieties of schists, as they graduate imperceptibly into each other in lenticular masses. Occasionally the beds become very quartzose, particularly in the north-western portion of the district, and sometimes a slightly calcareous tendency becomes apparent. A little east of Breen there occurs a lenticular bed of blue crystalline limestone, about nine feet in its thickest part, in grey micaceous schist; and in Stroanbay burn another thinner bed was noted.

The rocks which lie to the south-west of the granitic protrusion north-west of Cushendun are highly felspathic and gneissose in character, grey and pinkish in colour, weathering white.

In all cases the beds are highly foliated and contorted, containing numerous veins and strings of white quartz, both along and across the foliation.

The general strike in the western portion is north-east and south-west; in the centre of the district it ranges east and west, from this the beds roll over and range north-west and south-east; while north of Cushendun, where the dark green hornblendic rocks prevail, the strike is north-east and south-west. This sudden change in the direction of the strike is probably due to a fault which runs along the course of the Milltown burn.

Thin pink and grey pegmatite veins are common throughout the series, but more especially in the hornblendic schists north of Cushendun, where they occur along the joints and fractures of the strata.

AQUEOUS ROCKS.

*Lower Old Red Sandstone**—"*Dingle Beds.*"—These rocks are well exposed inland and along the coast, and extend in a broad belt or ridge, one and a half miles wide by six in length, from Cushendun southwards to Cushendall, and inland up the Ballyemon glen, where they narrow out and become overlapped unconformably by the New Red Sandstone. They rest on the metamorphic rocks, and dip at angles varying from 30° to 60° south east, the strike of the beds being due N.E. and S.W.

The basal beds, which are best seen at the old sea caves of Cushendun headland, consist of massive pebbly conglomerates. There are, however, some fine-grained obliquely laminated red and brown lenticular beds of sandstone alternating with them at Cave House; these were at one time extensively quarried and shipped to Belfast for building purposes.

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* These rocks were described by the late Dr. James Bryce, in the Transactions of the Geological Society of London. Second Series, Vol. V. p. 69.

The pebbles composing this conglomerate are principally those of vein quartz, quartzite, and occasionally felstone porphyry—all being very well rounded, and varying in size from that of a pea to twenty inches in diameter. Sub-angular fragments of mica schist are rarely to be met with in the mass—the whole being enveloped in a brown and red sandy material. The strata are much jointed and broken by numerous small dislocations.

Higher up in the series, the beds become less coarsely conglomeratic and more felspathic in composition; while, in the coast sections north-east of Cushendall, they are almost entirely composed of the fragments of felstone-porphyry of the district, forming a very coarse and massively bedded breccia or conglomerate, containing angular and sub-angular blocks of felstone up to three, and sometimes four, feet in diameter.

South-west of Cushendall, in the Ballyemon glen, exposures show that the beds become more sandy and flaggy in character, though still conglomeratic at the base. Many actual junctions between those rocks and the underlying schists are exposed between Cushendun and the head of Ballyemon glen, along the western boundary of the formation, notably in a stream a little east of Drumnacur Cottage, and again, a little west of Cloghs Lower. Red and brown colours predominate, but grey and yellowish beds are also to be met with. The thickness of the formation in this area appears to be about 5,000 feet, but as it is formed of shore beds the thickness may be much less.*

A. McH.

Triassic.

Keuper Marls.—North of Carnlough, and extending as far as Drumnasole, the red and green mottled marls are exposed along the shore, having a slight inclination to the west.

East of Drumnasole House, the low ground is covered with accumulations of Chalk, Lias and Basalt slipped from the high ground, but the Red Marls are exposed on the shore at low water.

At Straidkilly Point, S. of Carnlough, mottled red and green marls dipping S.W. at low angles are exposed continuously along the shore; these marls split up into cuboids in weathering.

The area coloured as Triassic on the map to the N.W. of Garron Point, is covered with great accumulations of fragments slipped on to the marls from the high ground, amongst which there are patches of bright red and green marl; but one section was seen of blue Lias clay over green and red marl all apparently horizontal. This section occurs at the base of the escarpment a few yards west of the mearing separating Fallowvee from Galboly Upper.

At Doory bridge in the Glenariff valley, red marls with green stripes are found in the stream, and to the north of the bridge near Gortin, bright red, friable, decomposing sandstones are met with in the banks of the burn.

On the south side of the Glenariff valley, the red marls are exposed in the railway cutting, and although on the map a large area is coloured as New Red Sandstone, there are no other exposures, owing to the great accumulation of talus from the escarpment.

---

* This district has been well described by the late John Kelly, C.E., in the Proceedings of the Royal Irish Academy, Vol. X., p. 269, (1868).

On the western margin of the sheet, Triassic beds are met with on the west side of the River Bush, consisting of decomposed bright red sandstone with occasional pebbles of quartz and mica schist, derived from the metamorphic rocks which are very close.

West of Ballyknock hill, which is also in the west of the district, the sandstones were met with when well-boring; one well is eighty feet in red sandstone, and not far from that another well was sunk into seventy feet of the same rock.

R. G. S.

The rocks of this group of strata are fairly represented in the district south of Cushendall, and are visible in several good sections overlapping the felstone-porphyry, Old Red Sandstone, and Metamorphic Rocks. Its basalt parts are remarkable for the close resemblance they bear, both in composition and lithological character, to the Old Red Conglomerate to the north and west. On the shore at Cushendall Coastguard station fine sections are exposed of massive conglomerate, the well rounded blocks and pebbles being, like those of the Old Red Sandstone, principally composed of vein quartz, quartzite, and occasionally felstone-porphyry and granite, some mica schist, and rarely, large rounded blocks of Old Red Conglomerate—all of which are enclosed in a friable material of red and brown coarse and fine sand.

The dip of the beds is S.E. at 40° to 30° at their basal part. As they are ascended in the section towards Red Bay, they become more sandy and brecciated, and less compact in texture. The angle of dip also becomes smaller, till finally at the village of Waterfoot the beds become horizontal, and change in character to obliquely laminated fine-grained sandstone. As we still ascend in the series towards the base of the overlying Cretaceous Rocks, they assume a finer and softer structure, till finally they pass upwards into soft red marl with grey and greenish shale partings.

This character holds good in all cases where the rocks are seen exposed. At the head of the Ballyemon valley the deposit thins out, as well as does the Old Red Sandstone which it overlaps, and in consequence of their proximity to the fundamental schist, fragments are abundant in both the formations.

The probable thickness of the deposit from its base at the Coastguard station to the base of the overlying Cretaceous rocks on Lurigethan mountain is about 700 feet. The colour varies from prevailing bright brick red to brown and yellow, and oblique lamination prevails throughout the series.

In the extreme north-western portion of the sheet, along the Bush river, just east and south-east of Ballyhoe bridge, good sections are exposed in the river banks, of soft bright red obliquely laminated sandstone, with dark red, yellow, and greenish marl partings. These beds dip west at 10° to 20°, the underlying rocks being mica-schist.

A. McH.

Rhætic and Liassic.

The Lias clays are only represented on the east of the southern half of the sheet.

To the N.W. of Garron Point and along the shore, fossiliferous blue clays are met with among the numerous accumulations which have slipped from the high ground; the only evidence *in situ* was in the escarpment of Caranure mountain, one mile N.W. of Garron Point, where the clays are a few feet thick. West of Carnlough and near Drumnasole, the clays are met with in the escarpment, and are not probably more than two feet thick.

Near Straidkilly Point on the S.E. margin of the sheet, the saturated blue clays are found to ooze out on to the road, carrying with them great tossed masses of chalk and basalt. The Rhætic beds are probably present, but must be very thin, and are incapable of special representation on the Map.

R. G. S.

Cretaceous.

Upper Greensand.—The representative of the Upper Greensand in the southern half of the sheet is a bed about twelve inches thick, composed of pebbles of vein quartz, and Lias nodules in a chloritic sand. This conglomerate, which contains numerous Cretaceous fossils, may be considered as an old shingle beach, formed around the margin of the upraised land upon the submergence of the north-east of Ireland in the Upper Cretaceous period. On either side of the valley of the Bush, there is only one exposure of the Greensand conglomerate, although there are several exposures of the Chalk. Where this becomes very thin, its position is indicated by bands of red flints which are known to lie at the base of the basalt. In the Aldorough burn, about a mile and a half above its junction with the Bush river, large blocks of the Greensand conglomerate some two feet thick were found on the surface, and apparently left there by the quarrymen in quarrying for chalk.

One may travel eastwards along the Chalk boundary for miles without any evidence of the presence of the Greensand conglomerate, until on arriving at the Ballyemon valley, S.W. of Cushendall, where the pebble bed is very well seen along the road from Retreat Castle towards Cushendall, as well as in the gorge near the waterfall, and along the northern slopes of the valley.

Although the Chalk is well seen in the escarpments from Red Bay, round Garron Point to Carnlough, there is no evidence of the presence of the pebble bed; but no continuous section of the aqueous rocks can be examined, owing to the accumulations of *debris* from the hills.

R. G. S.

Upper Chalk—In the S.E. of the district the Chalk attains its maximum thickness. It is there quarried extensively, and shipped to Scotland and England. It presents the usual characters of the formation in the county Antrim, being a hard, brittle limestone, of a milk-white colour, traversed by numerous joints, and containing bands of flints, three to four feet apart.

South of Red Bay the Chalk is well seen in the escarpment, and is there quarried and exported. South of the pier it is about 100 feet thick, and has a general dip of about 10° to the S.E. In the escarpment from Red Bay round to Garron Tower, the white limestone capped with a mass of dark basalt, presents a lofty and precipitous line of cliffs. It is probably over 150 feet thick, but its base is not met with, owing to the talus of chalk and basalt. East of Garron Tower the limestone with the usual bands of large flints is seen on the shore to dip at high angles under the basalt; both chalk and basalt having been thrown down to the east about 180 feet by a N. and S. fault. (Fig. 5, page 30).

To the N. and N.W. of Garron Point, enormous masses of chalk have slipped down seaward from the escarpment, and these are now quarried and exported.

In the escarpment west of Carnlough, and extending from Garron Tower to the southern limits of the sheet, the position of the Chalk is very regular; the base of the formation is about 200 feet above the level of the sea, and the horizon of the iron ore about 800; the intervening 600 feet consisting probably of 450 feet of lower basalt and 150 feet of limestone.

In Carnlough an extensive trade is carried on in the shipping of limestone; the material being brought down from the quarries by a wire tramway.

At the S.E. of the district near Glenarm Bay, the Chalk is met with quite close to the road leading from Carnlough to Glenarm, but owing to the constant sliding of the Basalt, Chalk, and Lias, it is difficult to find it in its proper position.

In the Glenariff valley to the west of Doory bridge, the Chalk is extensively quarried for agricultural and building purposes; the upper surface, having the usual eroded outline, consists of horizontal flags of from one to two inches thick; the base of the formation was not met with, so the thickness must exceed 150 feet. S.E. of Doory bridge, the Chalk is met with on the west bank of the river, but it is a mass that has slipped from the escarpment to the west; red marls occupying the intervening slope.

To the west of the River Bush, near Shelton Park, the boundary of the Chalk as drawn on the map is hypothetical, owing to the great accumulations of Drift. South of this, the evidence seems conclusive that the thick beds of chalk that occur in the east of the district are here represented only by a foot or so of reddish flints.

North-east of Slieveanorra the formation is still very thin, but two exposures were found in troughs in the mica-schist in the Owenaglush river; similarly in the Glendun river, about two miles west of Slieveanorra, the Chalk occupies the inequalities in the surface of the underlying mica schist.

Owing to the predominance of flints over chalk in these last-mentioned quarries, the rock is but little used for agricultural purposes.

At Aghan mountain the position of the Chalk is well marked, not only by the out-crops, but by the numerous springs that burst from the base; its greatest thickness is not more than 30 feet, where it is seen resting on a very uneven surface of mica schist.

East of Tievebulliagh mountain, and in the Issbawn burn, west of Cushendall, the junctions with the mica schist can be seen.

Further south in the Ballyemon valley the Chalk attains a thickness of about 100 feet, and several junctions were noted between this formation and the New Red Sandstone.

R. G. S.

In the northern half of the district the Chalk is extensively exposed along the fine escarpments of Lurigethan and other mountains which surround the Glenariff and Ballyemon glens.

It is here about 80 feet in thickness, and as it contains fewer flints than usual, it is extensively quarried for agricultural and other purposes. The beds dip gently towards the hill on all sides, thus forming a basin-shaped plateau under the basalt.

The top surface is very irregular and much eroded, exhibiting deep trenches and pockets filled with stiff brown earthy matter, reddish flints, and occasionally trap.

No traces of the Upper Greensand or Pebble Bed occur here, but some distance up the Ballyemon glen, near Retreat tram-station, and also towards the head of Glenariff, it is well shown in several sections resting slightly unconformably on the New Red Sandstone.

The pebbles in this basal bed of the Cretaceous rocks, are almost entirely of white vein quartz, well rounded, and vary in size from one-eighth of an inch to two inches in diameter, enclosed in a chalky material, with green chloritic grains. The bed itself varies in thickness from 6 inches to 3 feet, and probably extends under the Chalk in all cases over the whole country.

In the north-western portion of the district, a little north-east of Armoy Church, there is a small belt of the Chalk seen lying nearly horizontal, and terminating against a north and south fault.

The summit of Croaghan mountain, three miles south-east of the foregoing locality, is capped by a small outlier of Chalk and basalt. No rock *in situ* is now visible, the face of the quarry being covered by the talus of basalt, but it has been at one time worked extensively, and burnt in kilns on the spot for agricultural purposes. From the evidence in the spoil banks, flints appear to have been abundant.

At the head of Glenshesk river, on the road between Cushendall and Armoy, the Chalk thins out to a few feet in thickness.

A. McH.

IGNEOUS ROCKS.

Tertiary Volcanic Rocks.

Lower Basalt.—In the west of the district the basalt lies in great tabular sheets almost horizontally, and is of an amygdaloidal and vesicular character, generally disintegrating rapidly into spheroidal blocks. The sheets are separated from one another by beds of bole, or decomposed basalt.

On Slieveanorra the thickness of the Lower Basalt must be close on 600 feet, as we find the lithomarge which lies upon the upper surface to be about 1,600 feet above the level of the sea, whilst the Chalk margin is 1,000 feet. If there is no fault, this locality shows that the Lower Basalt is thicker in the N.E. of Antrim than in the south, the general thickness in other parts of the county being about 450 feet.

At Aghan and Tievebulliagh mountains, west of Cushendall, the basalt lies in great sheets of dark microcrystalline rock, some of the beds being rudely columnar.

At the head of the Glendun river, north of Pollan bridge it is both tabular and columnar, containing zeolites.

Crockalough mountain east of Trostan is capped with sheets of Lower Basalt, the probable thickness being about 400 feet. Apparently there must be a small fault, with a downthrow to the west, between Crockalough and Trostan, as the former is 1,304 feet high, and all formed of Lower Basalt, whereas the level of the boundaries between the Upper and Lower Basalt on Trostan is 1,200 feet.

On the south side of the Glenariff valley, the escarpment is composed of almost horizontal sheets of vesicular and amygdaloidal basalt. A bed of ash was traced among the sheets when ascending the mountain S. of Milltown R. C. chapel; the thickness of these sheets was calculated at 450 feet.

Garron Tower is built on lower basalt which has been faulted down along the east, the downthrow being about 180 feet. The section, as seen at Garron Point, consists of about 150 feet of sheets of vesicular and amygdaloidal basalt, separated by beds of bole and disintegrated trap, which incline to the S.W. at various angles; the lowest mass which rests on the chalk is rudely columnar. (See Fig. 5.)

The presence of the bole and ash between the beds appears to indicate that a considerable interval of time elapsed between the outpouring of the flows.

In the escarpment west of Garron Tower, and in the cliffs extending round to Red Bay, there is a thickness of about 400 feet of tabular vesicular and amygdaloid basalt, with bole beds, and occasional beds of ash; the top bed under the lithomarge being columnar, and presenting a precipitous escarpment a quarter of a mile west of the Point.

The Aghanageeragh river which flows south of Slievenahanaghan mountain, exposes a continuous section of sheets of basalt; in one of the sheets a vertical vein of bole was observed.

The basalt about Omerbane in the S.W. of the Sheet is weathered out into terraces having a N.N.W. and S.S.E. direction, corresponding with the direction of the Drift ridges in the low ground to the west.

At the head of the Bush river, close to Slievenamaddy mountain, the section in stream shows rudely columnar and compact basalt, alternating with amygdaloidal and vesicular varieties, along with bright red beds of bole, and ash with pisolitic structure.

The Glenariff river and its tributaries show numerous sections of the Lower Basalt; at the junction of the Inver river the rock is amygdaloidal, north of that there are thick beds of compact basalt alternating with scoriaceous and vesicular masses containing geodes with zeolites, and thin seams of bole.

At Parkmore House, the stream cuts through a great thickness of platy decomposing sheets of amygdaloidal trap.

Between Cargan and Tuftarney hills, good sections are seen both in the river and railway cutting; in the former, compact basalt is found to rest on beds of bole, and that on decomposed basalt, and that again, on coarse crystalline trap. In the railway spheroidal columnar basalt is laid open; similar columnar basalt was met with S.W. of Glenravel House.

On the N.W. side of the Glenariff valley, near Doory bridge, the basalt occurs in great sheets, generally compact, with traces of ash and bole beds intervening.

A quarter of a mile S. of Doory bridge, the stream from the mountain at Altahaghy bridge flows along a dyke of platy, vertical jointed, basalt, which cuts through scoriaceous and amygdaloidal sheets with bands of bole, having a slightly pisolitic structure.

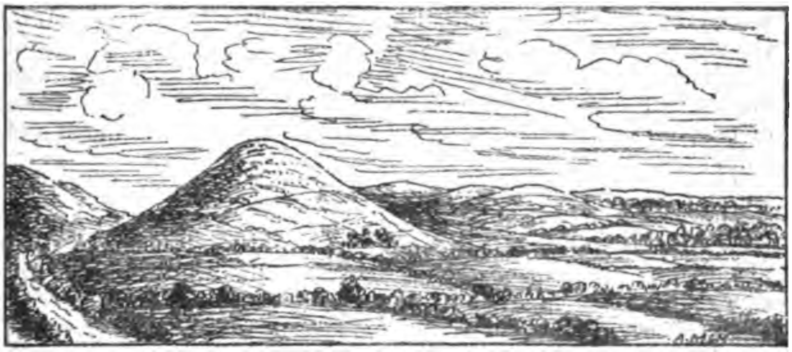
North of Carnlough, the basalt is chiefly amygdaloidal.

R. G. S.

Amygdaloidal and spheroidal dolerite of the Lower Division occurs north of Armoy church, capping the Chalk. It is here brought directly against the schist by a north-east and south-west fault. Similar dolerite, with red bole beds, caps the small outlier of Chalk on the submit of Croaghan mountain, and again it caps the escarpment of the same formation on Lurigethan hill.

A remarkable old neck, or vent, of basalt occupies the centre of the volcanic-looking hill of Tieveragh, a little north-west of Cushendall, where it breaks out through the Old Red conglomerate which is seen in close proximity. (See Fig. 3.)

Fig. 3.



Old Basalt Neck penetrating Lower Old Red Sandstone, Tieverah Hill, ½ a mile N.W. of Cushendall.

The centre of the neck is composed of a dark bluish grey compact rock, having a platy structure, while the outside portion is of the usual spheroidal dolerite.

A. McH.

Iron-Ore Deposits.—Throughout the district, immediately under the Upper Basalt a bed of aluminous iron-ore is generally found, composed of small spherules of hæmatite enclosed in an ochreous paste; underneath which there lies an aluminous layer more or less rich in iron-oxide. The iron-ore is only met with in the southern half of the sheet, and occupies a large area, being always capped by Upper Basalt.

On Slieveanorra mountain, Slievenahanaghan, Slieverush, and Tuftarney, a few small outliers of Upper Basalt occur, under which ore has been discovered. On Slieveanorra mountain the ore was found on the west side, about 1,550 feet above the level of the sea; north east of this, traces of the "pavement"* were found where the bog was cut through by the water from the top of the mountain.

On the north side of Slievenahanaghan, the ore was found by trials at about 1,100 feet above the level of the sea, the area occupied being very small; on the southern flank the outcrop is not exposed, the boundary between the Upper and Lower Basalt being hypothetical.

In the Glendun river, north-west of Trostan mountain, the "pavement" was found at 1,250 feet above the sea; but north and south of this, the boundary of the iron ore outcrop drawn on the map is provisional, owing to the great accumulations of bog and boulder clay by which it is concealed. On the east side of the mountain trials were made, and ore was proved, but not of sufficient thickness or quality to prove remunerative; pavement and lithomarge were also noted.

Ore was proved in the brook coming from the mountain, above Bay Lodge, Glenariff valley, at 900 feet above the level of the sea, and was very thin and irregular, with a bed of ash above and below it; a small fault here throws down the ore on the west.

One mile south east of Red Bay, ore was found above the waterfall. A fault also occurs here, the ore being thrown down to the east. The fault-rock is composed of angular pieces of basalt cemented with a steatitic material. The section showed twenty-five feet of pavement and lithomarge, with but a trace of ore; in the pavement were enormous bombs of rounded and exfoliating basalt.

All along the escarpment from Garron Tower to Red Bay, the ore has been proved at heights varying from 700 feet to 850 feet. The iron-ore is poor and most of the trials have been abandoned; the dip of the ore corresponds with the general south-westerly inclination of the volcanic sheets.

In the waterfall of the Ardclinis river, east of Red Bay, a bed of ash caps the iron-ore which is non-pisolitic. The usual pavement and lithomarge is always found under the ore, and two small outliers of the latter without ore were noted over columnar basalt, half a mile west of Garron Point.

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* "Pavement" is the local term for the decomposing ferruginous trap or volcanic tuff which underlies the pisolitic iron-ore.

North and east of the village of Newtown Crommelin, very extensive workings were formerly carried out, but in many cases they have been abandoned.

Two miles N. of the village, the iron-ore outcrop is exposed for about a mile, the thickness of the workable bed being about twelve inches; underneath the ore occurs a thick deposit of lithomarge, with numerous bombs of basalt in it, which exfoliate; the top of the bed is in distinct layers. One and a half miles N.N.W. of the village, the trials proved that in a very limited area, great changes may occur; either that the ore may be present or absent, or that the ore-bed may be replaced by another material, viz., bauxite. Where the trials were made, the ore was never found to be more than ten inches thick, while the bauxite was from three to four feet: the pavement and lithomarge underneath being over forty feet.

All along the high ground, east of the Inver river, which is a tributary of the Glenariff, the iron-ore was worked extensively, and carried by rail to Red Bay for shipment; for the most part these mines have been abandoned. Eleven adits were driven, and the ore of first quality was found to be on an average eleven inches thick, and second quality nineteen inches. The level of the ore-bed being about 720 feet above the sea, with an inclination of about 1 in 30 to the S.E.

West of the Inver river the outcrop is well defined, and the ore is better and thicker than on the east side, there being two to four inches of red pisolitic, and eighteen inches of black pisolitic ore; the inclination being to the W.S.W. at about 1 in 40.

At the Parkmore mines at the source of the Glenariff river, the ore is still worked by the Antrim Iron Company, and has proved remunerative; first quality (yielding 38 to 40 per cent.), being twelve inches thick; second quality six inches to two feet; third quality, six to eight feet; fourth quality (lithomarge) up to forty feet. No bauxite was found in this neighbourhood. Large crystals of calcite occur in the geodes in the basalt forming the roof of the mines. A downthrow fault of seventeen feet to the N.W. was encountered in the first workings of these mines, but the ore on the other side of the fault having been met with it was found that it increased in thickness away from the fault, the ore rising 1 in 22 to the west.

North of Parkmore mines, and in the stream west of Essathohan bridge, the ore is replaced by aluminous stuff; pavement and lithomarge being well exposed underneath.

South of the Parkmore mines the Agan burn exposes the ore, over which were found black fragmentary pieces of basalt, and then a sheet of decomposing vesicular basalt breaking up into horizontal flaggy pieces; no lithomarge or pavement was cut into by the stream.*

On the tongue-shaped hill called Skerry Rock, lying between

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* The cartage of ore from Mr. Fisher's tip head, at Parkmore, to Red Bay was 1*s*. 9*d*. to 2*s*. per ton. The Antrim Iron Ore Company sent their ore from same ground by rail to Belfast, *via* Ballymena.

Slieverush and Tuftarney hills, ore, bauxite, pavement, and lithomarge were proved, but the works were abandoned owing to poverty of the ore.

The mines worked at Cargan, N.E. of Newtown Crommelin, by the Antrim Iron Ore Company, are rich; the following are the varieties produced:—

*No. 1. ore, guaranteed to give 40 per cent.
No. 2. „ no guarantee, sometimes gave 25 per cent.
No. 3. „ no guarantee, „ „ 18 „ „

Numerous dykes were met with in these mines, which shifted the position of the ore-bed; the general inclination of the bed was to the S.S.W. about 1 in 10.

At Dungonnell, in the Ballsallagh water, the Antrim Iron Company are working rich ore from 10 to 14 inches thick. North of these workings in the high ground, a bore hole was driven down by the same company 205 feet through the Upper Basalt, and no ore was proved.

On the S.E. side of the Glenariff valley, and along the escarpments the ore no doubt exists, but no trials have been made; it is proved, however, by the section in the burn which flows from Lough Natullig over the cliffs east of Craignagat, the ore being about 10 inches thick.

In the high ground north of Carnlough and up to Garron Tower, numerous trials have been made, but pavement and lithomarge were only met with, except at the waterfall in the Black burn, west of Drumnasole House, where traces of the ore were seen.

Two miles west of Carnlough, the section of basalt capping the iron-ore deposits is well seen in the Cranny river; the pisolitic ore resting on pavement in which are numerous very large bombs near the top, is barely perceptible, and underneath there is a considerable thickness of lithomarge. On the north bank of the river the ore with pisolitic structure cannot be seen owing to the dykes which cut into and dislocate it.

From the above statement it will be seen that the working of the iron ore, at least in this district, is attended with great difficulties and disadvantages, owing to its variable quality, its occasional absence altogether, and the numerous faults and trap dykes by which it is affected. Under these circumstances, taken in conjunction with the depressed condition of the iron trade, it is not surprising that a great deal of capital has been sunk in abortive undertakings. It may be hoped, however, that as the districts where the ore occurs under the more favourable circumstances have now been proved, a revival of trade, and the excellence of quality of the Antrim ore itself, may ultimately lead to the development of an important and remunerative branch of industry.

Upper Basalt.—In the southern and central portions of the map all the highest elevations are capped by thick sheets of Upper

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*The estimated weight of the pisolitic iron ore, taking an average between very wet, and very dry, is about 1 cwt. to the cubic foot.

Basalt; the boundary however is generally well defined, not only by the outcrop of the pisolitic iron-ore and its underlying tuffs, but by the numerous springs that burst through when the rock is concealed by a coating of Drift.

West of Garron Point, the Upper Basalt is found in great sheets carved out into terraces, and covered with peat and boulder-clay. At Galboly, N.W. of Garron Point, this basalt forms the cap to the escarpment; no columnar structure was visible, and the sheets are composed of amygdaloidal, vesicular, and spheroidal basalt with traces of bole between.

North of Newtown Crommelin, and extending over as far as Slievenanee mountain, it occurs also in thick sheets, decomposing rapidly, the boundary between it and the Lower Basalt being well defined by the numerous trial pits for the development of the iron-ore.

Evish hill, Craigagh, and Cargans are composed of great sheets of vesicular, and amygdaloidal basalt, almost horizontal, and weathered out into terraces.

East of the Glenariff valley, the high ground is capped with horizontal sheets of Upper Basalt, the hollows in which are filled with thick spongy peat; some of the beds, especially the top bed over the escarpment near Callisnagh bridge, are rudely columnar, and bands of bole are frequent.

To the east of Loughatrosk, which is about two miles N.N.E. of Carnlough, there is a broad ridge of very compact highly crystalline basalt with olivine, running in a N. and S. direction, corresponding in many ways with the masses filling "fissures of eruption" in the Ballymena district south of this; all around the lough the rocks are well planed by glacial ice.

On Trostan mountain, the Upper Basalt is estimated to be about 600 feet thick, and consists of tabular amygdaloid, and vesicular trap slightly inclined to the S.W.; no columnar structure was observed. Here probably the maximum thickness is found, and both Upper and Lower Basalt are worn into terraces.

R. G. S.

Dykes.—In the extreme west of the southern half of the sheet, dykes are very numerous; at the same time they are insignificant as regards size, rarely exceeding a few feet across.

In the head waters of the Bush, south of the Altnahinch burn, two dykes running in a N. and S. direction were noted; one was six feet wide, breaking up into great scythe-shaped pieces at right angles to the direction; the other weathering into spheroids. Half a mile east of these, a dyke was met with in the bed of the river, also running in a N. and S. direction, and may probably be an extension of some of the dykes to the south. Following the course of the Bush, a dyke breaking up into scythe-shaped pieces was noted, running in a N. and S. direction west of the junction of the Altnahinch burn and the river Bush. Two miles north of this, and also in the Bush river, a dyke of basalt runs in an E. and W. direction North of the hamlet of Crockan.

A mile N.W. of Crockan, there is an insignificant dyke running

N. and S. through the New Red friable sandstone, and two miles S.W. of Crockan, narrow dykes of decomposing basalt are met with in the mica schists running N. and S.

On the N.E. side of Slievenahanaghan, two unimportant dykes are met with in the Lower Basalt immediately under the iron-ore; they are parallel, and run N.W. and S.E.

In the Aghanageeragh river, south of Slievenahanaghan mountain, three dykes were noted; two of which run N.N.W., and the third ranging in an E. and W. direction, breaks up into scythe-shaped pieces at right angles to the direction.

Near Ballybogy Lower, in the S.W. of the sheet, there is a large dyke of massive crystalline basalt, with a vertical platy structure; this dyke extends into the sheet to the South, and has a N.W. direction. Two miles N.E. of this, a small narrow dyke is met with in the roadway S.E. of Omerbane, having a similar direction to the last one.

A mile north of Newtown Crommelin, there is a big dyke in the bed of the Skerry river, running N. and S., and half a mile W. of this dyke, two were noticed in the lithomarge running in the same direction.

In the Skerry water, half a mile N. of Newtown Crommelin, four dykes close to one another, were noted, with a W.N.W. direction. In the trials made at Slieverush, Skerry rock, and Tuftarney hills, dykes were met with in the pavement and lithomarge.*

A mile S.W. of Newtown Crommelin, an E. and W. dyke is met with in stream N. of Montalto Glebe.

East of Tuftarney hill, in the low ground, there is a broad dyke of basalt with olivine; this dyke forms a great wall about six feet high running in a N.W. direction. N.E. of Tuftarney bridge, several dykes were met with in the excavation for the ore deposits.

In the Lower Basalt in the Cargan water opposite Chambers' mine at Evishacrow, three dykes were noted, two in a N. and the other in a N.W. direction. Where these dykes occur, numerous zeolites and mesotype crystals were found in the Lower Basalt sheets.

In the Glenariff valley, west of Doory bridge, five dykes were noted in the escarpment of Lower Basalt; the general directions being N.N.W. In the escarpment E. of the bridge, only one dyke was noted cutting through the Upper Basalt in a N. direction.

Two miles S.W. of Cushendall, in the Issbawn burn, there is a dyke of compact basalt running in a N.N.W. direction; it is much jointed and breaks up into spheroids.

At the waterfall at the head of the Ballyemon river, a dyke forms the fall; N.E. of this there are two small dykes in the river.

In the Upper Basalt, a mile S.E. of Red Bay, there is a dyke running N. and S. and twenty feet wide.

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* In the Explanation to accompany Sheet 20, allusion is made to similar dykes being so frequent in the iron ore deposits.

A mile and a half S.S.W. of Red Bay, near Greenaghan Cottage, a small E. and W. dyke was met with, traversing the base of the Chalk, and tilting the beds to an angle of 40°.

N.W. of Garron Point, a large dyke of amygdaloidal trap is seen cutting through the Lower Basalt and Chalk, and extending for a considerable distance in a N.N.E. direction; owing to the shingle, this dyke is not observed on the shore.

North of Carnlough and west of Drumnasole House, there is a large basalt dyke 18 to 20 feet wide, running N. 30 W., and traceable for about half a mile; it stands out as a large wall as much as forty feet above the Lower Basalt sheets which it penetrates.

On the shore N. of Carnlough Harbour, there are five narrow parallel dykes running in a N.N.W. direction; the broadest of these dykes is 6 feet. Numerous dykes occur in the Cranny river close to the position of the iron-ore; the largest forming the ledge of the waterfall.

South of Carnlough Bay and N. of Straidkilly Point, there is a basalt dyke 6 feet wide running N.E. and S.W., and half a mile S.W. of Carnlough, there is a dyke about 15 feet wide running N. and S. through the New Red Marl.

The Black Rock just N. of Straidkilly Point is apparently a volcanic pipe composed of coarsely crystalline dolerite, different from the ordinary bedded trap; it is rudely jointed, the joints concentrating to a centre.

R. G. S.

In the northern half of the district, also, numerous dykes of black compact basalt are to be met with penetrating both the new and old strata. The finest example is a branching dyke south-west of Red Bay tunnel, the main part of it which is exposed on the shore being about twenty feet wide, with branches four to five feet across. This dyke breaks through the New Red Breccia and Sandstone which it indurates and changes the colouring from bright red to light grey and brown; it is traceable in a north course for about a quarter of a mile.

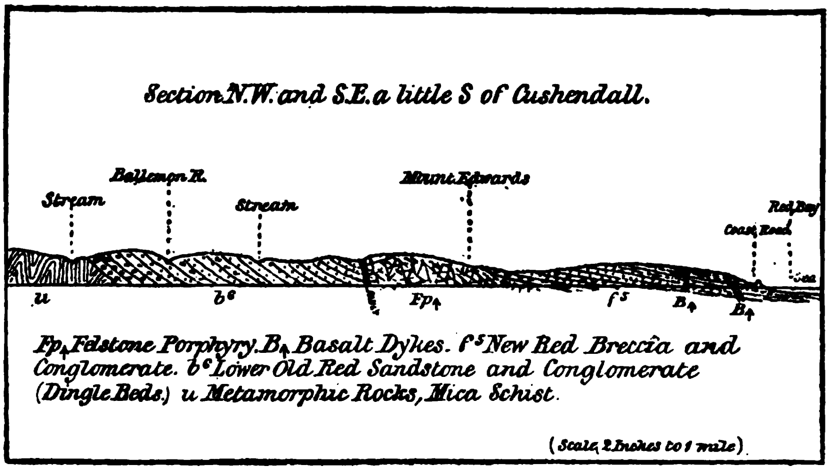
At Limerick Point another thin branching dyke is visible, cutting through the felstone porphyry and Lower Old Red Sandstone; and a little west of Cushendall is another large dyke penetrating similar strata. This latter dyke is probably a continuation of the one which is visible in three places a little north-west of the village.

A. McH.

Older Porphyries.

Felstone Porphyry.—South of Cushendall a mass of felstone porphyry occurs, ranging north-east and south-west. It is about one and a half miles long by half a mile wide at its broadest part, and is well seen for half a mile along the coast, south of Limerick Point, and at several places inland. The colour varies from dark blue and purple, to greenish brown and gray, and

Fig. 4.



Section N.W. and S.E. a little S of Cushendall.

$Fp_{\uparrow}$ Felstone Porphyry. $B_{\uparrow}$ Basalt Dykes. f^5 New Red Breccia and Conglomerate. b^6 Lower Old Red Sandstone and Conglomerate (Dingle Beds.) u Metamorphic Rocks, Mica Schist.

(Scale, 2 Inches to 1 mile).

the texture, from compact to friable. The large quarry south of Cushendall exhibits the dark blue, green, and purple compact variety, containing numerous small crystals of felspar, both orthoclase and plagioclase, with blebs of smoky quartz; also a pale green mineral, probably chlorite. This rock is very brittle, much jointed, and breaks with a smooth conchoidal fracture. It is much used as road metal, for which it is well suited. This is also the character of the rock exposed at Knockans, the most southerly part of the mass, and generally of the greater portion. The southern part of it, however, is less compact, and paler in colour. A little south of Limerick Point veins of red jasper are to be met with in the joints of the porphyry. Just west of Cushendall a small isolated boss of the compact variety protrudes through the Old Red rocks, on which is erected the ancient stronghold of Court M'Martin.

This porphyry is undoubtedly pre-Devonian, as is evidenced by the Lower Old Red Sandstone to the north and west of it being largely composed of its fragments. It is not improbably of Upper Silurian age.

Quartziferous Porphyry.—A short distance north-west of Cushendun a remarkable boss of red and pinkish granitoid rock (weathering brown and white) is found protruding through the gneissose schists. On its south-western boundary foliation is visible, and it appears to pass gradually into the schist. The centre and north-eastern portion, however, is massive and appears distinctly intrusive. In composition it is highly felspathic, containing large crystals of red orthoclase, and smaller crystals of transparent and white plagioclase, quartz-blebs, and mica (black, bronze, and white) in a felspathic matrix. Narrow dykes and small bosses of similar rock are to be met with along the coast north of Cushendun, and inland, breaking through the hornblendic and felspathic schists.

A. McH.

POST PLIOCENE.

The Drift-deposits consists of Boulder Clay overlain in some places by beds of stratified gravel and sand.

In the N.W. portion of the southern half of the sheet, a thick deposit of boulder clay occurs on the mountain slopes, containing a large quantity of blocks of the metamorphic series, while in the low ground are thick deposits of sand and gravel with a general tendency to form ridges in a N.W. direction. Resting on the ridges are numerous blocks of the metamorphic rocks.

The Drift is well seen in the cuttings made by the Glendun river, as well as on the eastern flank of Slieveanorra, consisting chiefly of basalt blocks and a few flints; on the boulder clay east of Slieveanorra numerous erratics of schist are to be found.

The section in the Glenaan river shows sixty feet of boulder clay with basalt *debris*. On this are also numerous erratics of schist, showing that the ice came from the N.E.

To the south of Slievenahanaghan mountain, the Aghanageeragh river cuts through thick boulder clay; at the head of the valley there is a forty feet section, the upper fifteen feet consisting of re-arranged Drift; lower down are esker-like mounds consisting of sand and gravel.

In the S.W. of the district, there is a considerable thickness of Drift in the lower, as well as the higher, ground, generally worn into ridges, having a N.W. and S.E. trend.

Near the hamlet of Ballybogy High, numerous angular pieces of trachyte were noted. These may either indicate that the floor of the Tardree trachyte may possibly extend in a northerly direction further than is marked on Sheet 20,* or that some other trachyte boss lies among the basalts further north.

Around Newtown Crommelin, the Drift is very thick, and consists of rounded striated blocks of basalt in a red ochreous clay.

In the Glenariff valley, N. of Doory bridge, a large block of conglomerate was noted lying on the boulder clay, which must have been transported from the north-east. R. G. S.

The Boulder clay spreads over the northern district, with the exception of the highest part of Cross Slieve hill, north of Cushendall, the top of Gruig mountain, and the high ground north-west of Cushendun.

In the rest of the country it is to be met with on the tops of the highest hills.

In the Glenshesk river valley, banks of clay, sixty to seventy feet thick, are to be seen. The general character is stiff reddish brown and grey clay enclosing striated boulders and fragments of the local rocks; occasionally lenticular beds of fine gravel and sand are to be met with in sections of it. In the Glendun river valley the Drift is exceedingly rocky, and contains enormous boulders of schist, some blocks measuring 25 x 18 x 15 feet. On the hill tops the colour of the boulder clay is invariably gray and light brown, and contains smaller rock fragments.

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* Page 10 of the Explanation of that Sheet.

Interglacial Sand and Gravel.—These deposits, consisting of beds of stratified sand and gravel containing in the district to the north marine shells, are to be seen in several instances capping the lower boulder drift—notably in the Glenshesk valley —also in the Glendun and Bush valleys.

A. McH.

Recent Accumulations.

Bog.—The great horizontal sheets of upper basalt which cap the higher elevations are overlain by peat in considerable thickness, which extends for miles in an unbroken line, except where the streams cut through.

One of these great tracts caps the ground from Trostan mountain over Eagle hill, Bush head, on to Slieveanorra; another caps the high ground from Collin Top in the S. to Knockore, six miles to the N.E.; this latter bog is dangerous to travel over.

All the high ground in the central and northern portions of the district is covered by extensive peat bog, sometimes of great thickness and extending even over the mountain tops in unbroken sheets.

In the low ground in the extreme west of the district, peat fills up the intervals between the several ridges of sand and gravel.

R. G. S.

Alluvium.—Small deposits of alluvium exists here and there along the river courses. For a mile and a half south-west of Cushendun a considerable tract of alluvial soil occurs, which forms the best tillage land in the district.

A. McH.

Raised Beach.—South of Carnlough there occurs a raised beach composed of rounded pieces of chalk, extending in a southerly direction from Harphall House, the surface of which is about twenty-five feet above the level of the Ordnance datum; numerous worked flints, bones, &c., were found in the neighbourhood of Oscar Lodge.

R. G. S.

Raised beaches occur at Cushendun and Cushendall, the terraces being well marked along the coast from Glenariff to Cushleak, and merging from the twenty-five to the forty feet contour line. Several fine old sea caves, now some feet above the high-water line, exist in the New Red Sandstone south of Cushendall. There are also some good examples in the Old Red Conglomerate a little south-east of Cushendun, as described in page 9. A. McH.

Blown Sand.—A barrier of blown sand separates the great alluvial tract in the Glenariff valley from the sea at Red Bay; the surface of the alluvial flat is about fifty feet above the level of the sea, and it is presumed that its bed is part of a raised beach. R. G. S.

CHAPTER III.

PRINCIPAL FAULTS.

Of the few faults which traverse the northern portion of the district, the principal one is that which is first traced in the Ballyemon glen two and a half miles south-west of Cushendall, and which runs in a north-east direction a little west of the village. This fault throws down the Old Red Conglomerate on the west, bringing the edge of the beds directly against the felstone porphyry and New Red Sandstone. A cross fault joins the main one in the river west of Cushendall, bringing up a small knob of the felstone-porphyry at Court M'Martin. Another small north and south fault occurs in the Ballyemon glen, throwing down the Old Red Sandstone on the west.

Just south of Armoy church a continuation of a fault in sheet 13 to the west comes in. It is joined by a north and south one near the R. C. chapel, and both together throw the Chalk and basalt down on the north-west. Numerous small dislocations are to be seen along the coast and inland, but none of them are of sufficient importance to deserve special description.

A. McH.

The largest fault in this district occurs near the western margin of the sheet, with a downthrow to the west.

In proof of this we have the Lower Basalt thrown down against the schists without any evidence of the underlying Chalk, or New Red Sandstone, independently of the fact of the iron-ore deposits being at a much greater elevation in this sheet than is the case with the proximate exposures in Sheet 13 to the west. The level of the pisolitic iron-ore outcrop on Slievenahanaghan mountain is about 1,200 feet, whereas that of the iron-ore out-crop west of Killagan in Sheet 13, and about two miles west of the fault, is only about 400 feet above the sea.

Along the escarpment, west and north of Garron Point, numerous small faults occur, which help to increase the landslips in that locality. At the spot where the fault approaches the shore, a quarter of a mile N. of Garron Point, a copious fountain of pure water bursts out from beneath the Chalk.

North of Newtown Crommelin, there is a very well marked N. and S. fault, the downthrow of 150 feet to the east being well proved by the trials in search of the pisolitic iron-ore.

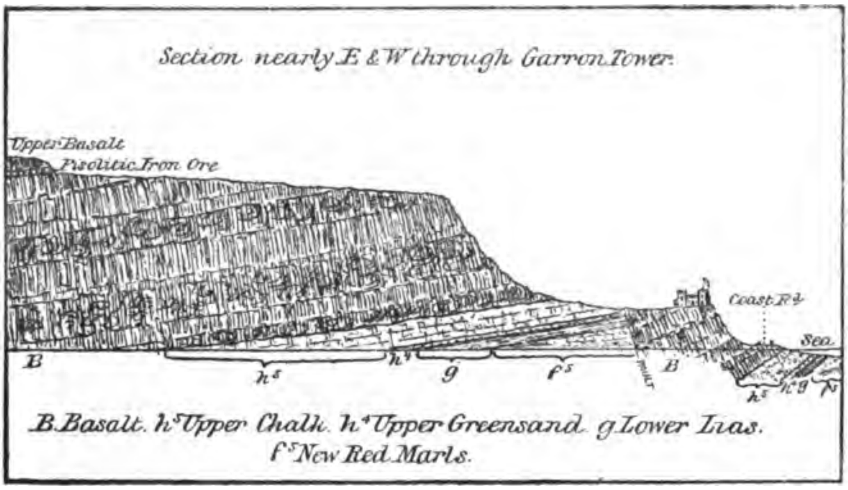
At the source of the Glenariff river, near Rock House, and parallel to the Cushendall Railway, there is probably a N.N.E. fault with a downthrow towards the S.E., as the position of the iron-ore deposits on the N.W. is over 1,000 feet above the sea, while to the S.E. it is about 750 feet; as no conclusive evidence for this view can be produced no fault is recorded on the map.

In the Glenariff valley, east of the junction of the Inver river with the Glenariff, there is a visible fault; the Chalk being thrown down below the New Red Sandstone about 150 feet to the E.S.E. A mile and a half to the S.W. of the last mentioned locality, a fault occurs in the waterfall of the Inver river, which may either be an extension of the Glenariff fault, or a parallel fault of the same age.

West of Carnlough, in the Cranny river, there is a N.N.E. fault, by which the basalts and iron-ore deposits have been thrown down 200 feet to the east.

One of the most recognisable faults in the district is that which occurs about three miles N. of Carnlough, and extends for about a couple of miles in a direction parallel to the shore line. The fault is about 180 feet with a downthrow to the East. On the prominent platform produced by the sheets of basalt on the downthrow side of the fault, is built the noble mansion of Garron Tower, the seat of the Marquis of Londonderry, and from the edge of the escarpment descends a magnificent cliff to the margin of the sea, in which may be seen the dark basaltic mass, surmounting the beds of white chalk; the flanks of this scarp are densely clothed with natural timber.

Fig. 5.


Section nearly E & W through Garron Tower.
Upper Basalt
Pisolitic Iron Ore
Coast Rd.
Sea
B
h^5
h^4
g
f^5
Fault
B
h^5
h^4 g
f^5
B Basalt. h^5 Upper Chalk. h^4 Upper Greensand. g Lower Lias.
f^5 New Red Marls.

At the base of the cliff, east of Garron Tower, there are undoubtedly repetitions of the strata by parallel faults, from the fact of the Chalk dipping at such very high angles to the S.W. and W. even as much as 70°, and thus causing the formation to appear much thicker than is really the case; the greatest thickness of that formation in this part of County Antrim not exceeding 150 feet.

R. G. S.

GLACIATION.

The following cases of glacial striations were observed over the southern half of the Sheet:—

Six-inch Map.	Townland.	Locality.	Striæ.
Antrim. $\frac{19}{1}$	Beaghs.	In the Glendun river.	N.E. and S.W.
$\frac{20}{3}$	Greenaghan.	In Railway cutting.	N.E. and S.W.
$\frac{24}{3}$	Tuftarney.	In river east of hill.	N. 85 W.
$\frac{24}{3}$	Irishomerbane.	In stream S.E. of Slieverush hill.	N. 45 W.
$\frac{25}{1}$	Clonreagh.	On Lower Basalt on high ground.	N.E. and S.W.
$\frac{25}{2}$	Scaryhill.	On east side of Loughatrosk.	N. 60 E.
$\frac{25}{3}$	Harp Hall.	On terraced Upper Basalt.	N. 70 E.

R. G. S.

On the high ground above Craigagh wood, a mile and a half west of Cushendun, very good striæ, going S.S.E., are visible on the bare schists. This is the only locality in the northern portion of the map where the striæ were noted, but the physical features of the country and thick covering of boulder Drift indicate extensive glaciation over the whole district.

A. McH.

CHAPTER IV.

PALÆONTOLOGICAL NOTES.

LOCALITIES from which FOSSILS were collected.

No. of Locality.	Quarter Sheet of 6-inch Map.	County and Townland.	Situation and Geological Formation.
		Co. of ANTRIM.	RHÆTIC and LOWER LIAS.
1	25/4	Parishagh, . .	Slipped masses of rock, on coast road, one mile north of Glenarm, two miles south-east of Carnlough.
2	20/4	Galboly, Upper, .	Rocks on shore under coast road, about half a mile north-west of Cloghastucan, half a mile north of Garron Point, and five miles north of Carnlough.
3	20/4	Galboly, Lower, .	Rocks on shore under coast road, a little north-west of Garron Point.
			CRETACEOUS—UPPER CHALK.
			"*Chloritic Chalk*," and "*White Limestone*."
4	19/2	Glenaan, . .	Rocks in stream about one mile south-west of Tievebulliagh mountain, and about three miles west of Cushendall; "white limestone."
5	19/2	Cloghs, . .	Quarry on north-east face of Tievebulliagh mountain, about three miles south-west of Cushendall; "white limestone."
6	19/2	Eshery, . .	Quarry on north side of Aghan mountain, about three miles west of Cushendall; "white limestone."
7	19/4	Retreat or Cloghglass.	Quarry on road, a quarter of a mile north-east of Retreat Castle, and two and a half miles south-west of Cushendall; "white limestone."
8	19/4	Do., . .	Quarry on road from Retreat to Cushendall, about a quarter of a mile north of Retreat Castle; "white limestone."
9	19/4	Altcnore, Upper, .	Rocks in stream close to road, about half a mile north-east of Retreat Castle, and two and a half miles south-west of Cushendall; "chloritic" conglomerate bed.
10	20/1	Knockans, South, .	Quarry on north face of Lurigerhan mountain, one and a quarter miles south-west of Cushendall; "white limestone."
11	20/3	Drumnacar, . .	Rocks in stream at Glassanelly Burn, quarter of a mile south of Milltown R. C. chapel, five miles north-west of Carnlough; conglomerate.
12	20/3	Greenaghan, .	Rocks in stream a little south-east of Greenaghan cottage, about two miles south of Waterfoot, and four and a half miles north-west of Carnlough; "white limestone."
13	20/3	Kilmore, . .	Quarry at side of road from Glenariff to Ballymena, two miles south of Glenariff; "white limestone."
14	20/4	Nappan, . .	Rocks on shore half a mile south-east of Garron tower, and three and a quarter miles north of Carnlough; "white limestone."
15	20/4	Galboly, Lower, .	Cliffs over road near Garron tower, three and a half miles north of Carnlough; "white limestone."

Localities from which Fossils were collected—*continued.*

No of Locality.	Quarter Sheet of 6-inch Map.	County and Townland.	Situation and Geological Formation.
		Co. of Antrim—*con.*	
16	20/4	Galboly, Lower, .	Cliffs over road a little west of National school, Garron Point, four and a half miles north of Carnlough; "white limestone"
17	20/4	Do., . .	Rocks at junction of old road and coast road, near Cloghastucan, four and a half miles north of Carnlough; "white limestone."
18	20/4	Fallowvee, . .	Rocks at base of Caranure Hill, a little south of Fallowvee Pier, and about four and a half miles north of Carnlough: "white limestone."
19	25/2	Newtown, . .	Rocks in ravine at Drumnasale, three quarters of a mile north of Ringfad Point, and two and a half miles north of Carnlough; "white limestone."
20	25/4	Gortin, . . .	Quarry a little east of Gortin, and nearly one mile west of Carnlough; "white limestone."
21	29/2	Parishagh, . .	Quarry on face of hill half a mile north of Glenarm, on coast road, and two miles south-east of Carnlough; "white limestone."
22	29/2	Do., . .	Quarry west of upper road from Glenarm to Straidkilly, two miles south-east of Carnlough, "chloritic" conglomerate and "white limestone."
23	29/2	Do., . .	Quarry a little west of old road from Glenarm to Straidkilly, two miles south-east of Carnlough; "white limestone."

List of the Fossils collected from the Localities mentioned in the preceding Table.

The numbers opposite each species refer to the places at which they were collected, and the mark × placed before them denotes their comparative abundance.

RHÆTIC AND LOWER LIAS.

		Localities.
Avicula contorta	(Rhætic),	1, 2.
Axinopsis Ewaldi	(do.),	× × × 1.
Placunopsis Alpina	(do.),	× × × 1,
Exogenous Wood	(Lower Lias),	1.
Rhynchonella octoplicata	(do.),	3.
Astarte Geuxii	(do.),	2.
Cardinia Listeri	(do.),	2.
„ ovalis	(do.),	1.
Cardita rhomboidalis	(do.),	1.
Gryphæa incurva	(do.),	× × × 2, × × × 3.
Lima gigantea*	(do.),	× × × 1, 2.
Mytilus Hillanus	(do.),	2.
„ minimus	(do.),	1, 2.
Ostrea irregularis	(do.),	× 1, × × × 3.
Pecten lunalarius?	(do.),	3.
Ammonites Johnstoni	(do.),	1, × × 2.
„ planorbis	(do.),	1.

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* Including L. pectinoides and L. punctata as synonyms.

CRETACEOUS.—UPPER CHALK.—"Chloritic Chalk." "White Limestone."

Spongida.	Localities.
Amorphospongia per reticulatum,	4, ×5, 6, × ×7, 8, 12, 14, 18.
Cliona cretacea,	5, 19.
Coscinopora infundibuliformis,	×10, ×14, 17, 20, 22.
" tubiporacea,	14.
Ventriculites radiatus,	10, 20, 22.
Actinozoa.	
Parasmilia centralis,	22.
Echinodermata.	
Cidaris sp.,	7, 8, 14, 18, 26.
Echinoconus abbreviatus,	10, 18, 28.
" conicus,	5, 10, 17, 20, 21, 22.
Echinocorys vulgaris,	14, 15, 20, 22, 28.
Micraster cor-anguinem,	10.
Annelida.	
Serpula plexus,	22.
Vermilia ampullacea,	22.
Polyzoa.	
Desmeopora cylindrica,	21.
Holostoma contingens,	21.
Brachiopoda.	
Magas pumila,	12, 14, 15, ×16, ×18, ×19, ×20, 22.
Megerlia lima,	6, 7, 18, 21, 22.
Rhynchonella octoplicata,*	13, ×14, 17, 18, 20, 21, ×22.
Terebratula biplicata,	9, 22.
" carnea,	5, 6, 7, 8, 9, 11, 13, ××14, 15, 16, 17, 18, 20, 21, 22.
" obesa,	22.
" semi-globosa,	20, 22, 23.
Terebratulina striata,	4, 10, 12, 14, 17, 22.
Mollusca—*Conchifera.*	
Inoceramus striatus,	22.
" problematicus,	22.
" sp.,	9, 18, 22.
Lima elegans,	10.
" Hoperi?	22.
" ornata,	22.
" semisulcata,	22.
Ostrea vesicularis,	18, ×××22.
Pecten nitidus.	5, 10.
" quinquecostatus,	9, 22.
Spondylus spinosus,	12, ×××22, 23.
Gasteropoda.	
Patella sp.,	19, 22.
Pleurotomaria perspectiva,	22.
" Thomsoni,	23.
Turbo sp.,	23.
Cephalopoda.	
Ammonites Johnstoni,	1, ××2.
" planorbis,	1.
Belemnitella mucronata,	4, 5, 6, 7, ×10, 13, 14, 51, 20, 22, 23.
Pisces	
Corax maximus (Rev. Dr. Grainger's collection),	22.
Lamna accuminata,	22.
Otodus appendiculatus,	9 22.
Ptychodus mammillaris,	22.
Scales and bones of fish,	19, 22.

WILLIAM HELLIER BAILY.

~~*April*~~ *27th*, 1886.

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* With this species is associated R. plicatilis and R. limbata as synonyms.

INDEX.

Page
Agan Burn, . . . 21
Agangarrive, . . 7, 10
Aghan, . . . 9, 16, 18
Aghanageeragh River, . 10, 18, 24, 27
Aldorough Burn, . . . 11, 15
Altahaghy Bridge, . . . 19
Altnahinch Burn, . . . 23
Amygdaloid Basalt, . . 18
Aqueous Rocks, . . . 10, 12
Ardclinis River, . . . 20
Armoy, . . . 7, 9, 17
„ Church, . . 17, 19, 29
Ash, ... 18

Ballsallagh River, . . . 10, 22
Ballybogy, High, . . . 27
Ballybogy, Lower, . . . 24
Ballyemon Glen, 9, 12, 13, 14, 15, 17, 29
„ River, . . 7, 11, 24
Ballyhoe Bridge, . . . 14
Ballyknock Hill, . . . 14
Bawn River, . . . 10
Bauxite, ... 21
Bay Lodge, . . . 20
Beaghs, ... 31
Binnagee, ... 10
Blackburn, ... 22
Blackrock, ... 25
Bohilbreaga, . . . 7
Bole Beds, ... 18
Bog, ... 28
Breen, ... 12
Bryvore Water, . . . 11
Bush Head, . . . 28
Bush River, . 10, 11, 14, 15, 16, 23
Bush Valley, . . . 28

Calcareous Schists, . . 12
Calcite, . . . 21
Callisnagh Bridge, . . . 23
Caranure Mountain, . . 15
Cargans, . . . 10, 22, 23, 24
„ Hill, . . . 19
Carnlough, . 9, 13, 15, 16, 19, 22, 23, 25, 28, 30
Carn Neill, . . . 10
Cave House, . . . 12
Chalk, ... 10
„ thickness of, . . 16, 17
Chambers' Mine, . . . 24
Clogh Mills, . . . 9
Cloghs, Lower, . . . 13
Clonreagh, . . . 31
Collin Top, . . 9, 10, 28
Conglomerate, . . 12, 13, 14
Court M'Martin, . . . 26, 29
Craigagh, . . . 9, 23, 31
Craignagat, . . . 22
Cranny River, . . 22, 25, 30
Cretaceous, . . . 15
„ Fossils, . . . 34
Crockalough, . . 9, 10, 18
Croaghan, . . . 7, 9, 17, 19
Crockan, . . . 11, 23 24

Page
Crockaneel, . . . 7, 10
Crocknacreeva, . . . 7
Crystalline Limestone, . . 12
Cross, Slieve, . . . 9, 27
Cushendall, 7, 11, 12, 13, 14, 15, 17, 18, 19, 24, 26, 27, 28, 29
Cushendall Railway, . . 29
Cushendall River, . . . 10
Cushendun, 7, 12, 13, 26, 27, 28, 31
Cushleak, ... 28

Dingle Beds, . . . 12
„ thickness of, . . 18
Doory Bridge, . . 13, 16, 19, 24
Drainage, ... 10
Drumnacur Cottage, . . 13
Drumnasole, . . 13, 15, 22, 25
Dungonnell, . . . 22
Dykes, ... 28

Eagle Hill, . . . 10, 28
Escarpment, . . 18
Essathohan Bridge, . . 21
Evish, . . . 10, 28
Evishacrow, . . . 24

Fallowvee, . . . 13
Faults, ... 18, 29
Felstone Porphyry, . . 13, 25
Fossils, ... 32

Galboly, ... 18, 23
Garron Point, 10, 13, 15, 16, 18, 20, 23, 25, 29
Garron Tower, . 16, 18, 20, 22, 30
Glaciation, ... 31
Glenaan River, . . 7, 10, 11, 27
Glenariff River, . 10, 18, 21, 28, 29
Glenariff Valley, 9, 13, 16, 17, 18, 19, 20, 22, 23, 24, 27, 28
Glenarm Bay, . . 9, 10, 16
Glendun River, . 7, 10, 11, 16, 18, 20, 27, 28
Glenravel House, . . . 19
Glenshesk River, . . 7, 10, 17, 27
Glenshesk Valley, . . . 28
Gortin, ... 18
Granitic Protrusion, . . 12
Greenaghan, . . . 25, 31
Greensand, Conglomerate, . . 15
Guig Top, . . . 7, 27

Harphall House, . . . 28, 31
Hornblendic Schist, . . 12

Igneous Rocks, . . . 11, 25
Interglacial Sand and Gravel, . 28
Inver River, . . 18, 21, 29, 30
Irishomerbane, . . . 31
Issbawn Burn, . . 7, 11, 17, 24
Iron-ore deposits, . . . 20
„ „ thickness of, . 21

Jasper, ... 26

Page
Keuper Marls, 13
Killagan, 29
Knockans, 26
Knockore, 10, 28

Landslips, 10
Lias, 10, 15
Limerick Point, 7, 25, 26
Lithomarge, 20
Little Trcsk, 10
Loughatrosk, 23
Lower Basalt, 17
" " thickness of, 18
Lower Lias, 15
Lower Old Red Sandstone, 12
Lurigethan Mountain, 9, 14, 17

Maine Water, 10
Metamorphic Rocks, 11
Milltown Burn, 12
" R. C. Chapel, 18
Montalto Glebe, 24

Nanny's Cave, 9
Natullig Lough, 22
New Red Marls, 10
New Red Sandstone, 14
Newtown Crommelin, 9, 21, 22, 23, 24, 27, 29

Oghtbristacree, 7
Olivine, 23
Omerbane, 18, 24
Oscar Lodge, 28
Owenagluah River, 16

Palæontological Notes, 32
Parkmore House, 19
" Mines, 21
Pavement, 20
Pegmatite Veins, 12
Physical Geography, 7
Pisolitic Iron ore, 22
Pollan Bridge, 18
Port Vinegar, 7
Post Pliocene, 27
Principal Faults, 29

Quartziferous Porphyry, 26
Quartz Veins, 11

Page
Raised Beach, 9, 28
Recent Accumulations, 28
Red Bay, 7, 9, 14, 15, 16, 18, 20, 21, 24, 25, 28
Retreat Castle, 15
Rhætic Beds, 15
Rhætic Fossils, 32, 33
River Basins, 10
River Bush, 7
River Sources, 10
River Valleys, 7
Rock formations and divisions, 10
Rock House, 29

Scaryhill, 31
Schists and Gneiss, 11
Sea Caves, 9
Shelton Park, 16
Skerry Rock, 21, 24
Skerry River, 10, 24
Slieveanorra, 9, 10, 16, 17, 20, 27, 28
Slievenahanaghan, 9, 18, 20, 24, 27
Slievenamaddy, 18
Slievenanee, 9, 23
Slieverush, 9, 20, 22, 24
Straidkilly Point, 13, 15, 25
Stroanbay Burn, 12

Tertiary Volcanic Rocks, 10, 17
Tievebulliagh, 9, 17, 18
Tieveragh Hill, 19
Trachyte, 27
Triassic, 13
" thickness of, 14
Trostan Mountain, 7, 9, 18, 20, 23, 28
Tuftarney Hill, 19, 20, 22, 24, 31
" Bridge, 24
Tullykittagh River, 10

Upper Basalt, 22
" thickness of, 23
Upper Chalk, 15
Upper Greensand, 15
" thickness of, 15

Vesicular Basalt, 18

Waterfoot, 9, 14
Watershed, 10
Well Water Burn, 7

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